

# TITLE OF THE INVENTION

## PHASE-CHANGE INK COMPOSITION

### BACKGROUND OF THE INVENTION

[0001] The present invention is directed to a phase-change ink composition. More particularly, the present invention is directed to an ink that is a solid at room temperature, a single-phase liquid at a jetting or application temperature and that, upon solidifying, forms an elastic phase and a crystalline phase.

[0002] Ink jet inks are well-known in the art and remain a developing technology. These inks are used in a wide variety of applications, varying from home printing application to large scale, high-speed commercial printing operations.

[0003] There are two principal types of ink jet inks, namely, liquid inks and solid inks. Current liquid ink technologies focus on aqueous dispersions of various constituents that typically include, at a minimum, a carrier, a colorant or pigment, and one or more polymer-based constituents for providing integrity to the print media. These polymer based constituents are generally used to impart desired physical and chemical properties for the final use of the ink. Examples of these polymer-based constituents include binders, thickeners, thixotropic agents, coating aids and the like.

[0004] One type of solid ink used in ink jet printing is a hot-melt ink. These inks are typically non-aqueous. In a hot-melt ink or thermal ink process, the ink is melted by a heater in the printing head or device and thus is a liquid at its application or operating temperature. Typically, the vehicle for carrying the dye or colorant has a low critical temperature to facilitate melting and thus use of the solid ink. The ink is heated and melted and subsequently jetted as a "droplet" from the printing apparatus. Upon contact with the printed media the molten ink rapidly solidifies. The ink remains on the surface of the media because of this rapid solidification. This provides increased print quality in the form of higher print density and smaller, more regular dot size. It will be recognized that there are many advantages to hot-melt inks. One significant advantage is the decreased potential to spill the ink during handling.

[0005] Early hot melt inks were problematic vis-à-vis temperature stability. That is, the dyes in the inks were susceptible to thermal degradation. As such, pigments were adopted for use in favor of dyes. However, problems arose with

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respect to settling of the pigments or concentration of the pigments at ink-melt boundaries.

[0006] Later developments saw the rise of hot-melt vehicles formed of amide compounds. Mixtures of tetra-amide and mono-amide compounds were used, which tetra-amide compounds were formed by reacting ethylene diamene, dimer acid and stearic acid. The mono-amides used were stearamide. Tackifiers were added to promote adhesion to the underlying substrate or media. Anti-oxidants and plasticisers were also known to be used to increase flexibility and lower the melt viscosity.

[0007] Further developments saw the use of manipulated polymer cross-linking to achieve the needed phase change without using acidic polymers. It was found that acidic polymers resulted in increased corrosion of the printing apparatus. In one known hot melt ink, a reversible cross-linking material, namely oxyaluminum octotrate is mixed with a saturated, long-chain linear alcohol, a pigment, and anti-oxidant, and a corrosion inhibitor.

[0008] It has, however, been found that the known hot-melt inks require relative high operating temperatures. That is, the application temperature required for the printing device (i.e., melting the solid ink) is at least about 150°C. In addition, the print formed by currently known hot melt inks do not provide sufficient mechanical strength. That is, the integrity of the printed media may not necessarily meet rigorous standards and specifications for use in commercial applications.

[0009] Accordingly, there exists a need for an ink that is a single phase liquid at operating temperature and solidifies upon printing. Desirably, such an ink, upon solidifying, forms two phases, namely, an elastic phase and a crystalline phase. The elastic phase is reinforced by the crystalline phase to provide durable end user properties with high mechanical strength.

[0010] Such an ink provides high integrity text or printed media. Most desirably, such a hot melt ink can be used at temperatures less than about 150°C, and preferably, such inks can be used at jetting or operating temperatures of about 110°C to about 130°C.

#### BRIEF SUMMARY OF THE INVENTION

[0011] A hot-melt ink for use with an ink jet printing apparatus is a liquid at about 100°C to about 130°C and solidifies to a two-phase solid having an elastic phase and a crystalline phase. The ink has a formulation including a carrier, a

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[0044] In the present disclosure, the words "a" or "an" are to be taken to include both the singular and the plural. Conversely, any reference to plural items shall, where appropriate, include the singular.

[0045] From the foregoing it will be observed that numerous modifications and variations can be effectuated without departing from the true spirit and scope of the novel concepts of the present invention. It is to be understood that no limitation with respect to the specific embodiments illustrated is intended or should be inferred. The disclosure is intended to cover by the appended claims all such modifications as fall within the scope of the claims.

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